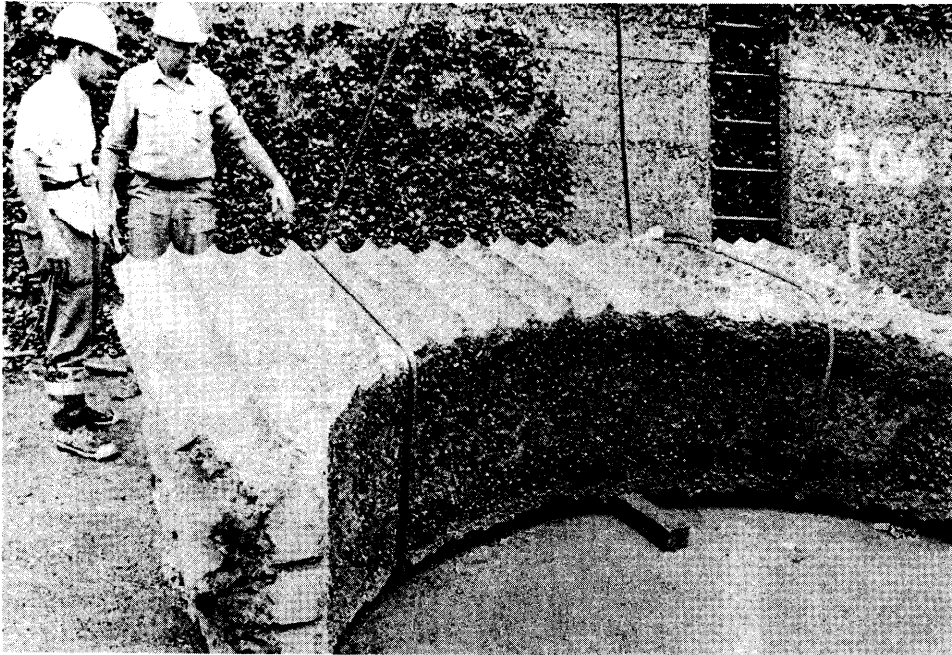




# REMR TECHNICAL NOTE CS-MR-1,7

## CONCRETE REMOVAL TECHNIQUE: STITCH DRILLING



Stitch-cutting technique used to cut out section of concrete at the Panama Canal's Gatun Lock

PURPOSE: To describe the use of stitch drilling as a technique for concrete removal.

APPLICATION: The stitch-drilling technique is used to produce cuts in concrete in which depths are greater than those that can be economically cut using a diamond blade saw.

ADVANTAGES: The stitch-drilling technique can be used to make deep cuts into more massive concrete, such as that found at the Corps' lock and dam projects. Cuts can be made into surfaces that are horizontal, vertical, or in between. Irregular shapes and curved edges can be cut.

LIMITATIONS: Stitch drilling is usually easier and less expensive than saw cutting when the depth of the cut is greater than 21 in. The maximum cutting depth will depend on the accuracy with which holes can be drilled. The deeper the cut, the greater the required hole diameter to maintain an overlap between adjacent holes. Using a small-diameter bit to make a deep cut increases the

potential for occurrences of uncut portions of concrete between holes. These uncut portions will hamper or prevent the removal of the section.

In situations in which the section to be cut out rests on a foundation, the bond between the concrete and the foundation plus any anchors that tie the concrete to the foundation must be broken or severed. If an economical removal technique cannot be employed to separate the concrete from the foundation, the optimum size of the cutouts must be reduced so that the lifting capacity of the equipment selected for the job exceeds the combined dead weight and bond forces. A demonstration is needed to verify the cutout size selected because of the uncertainty of the number and magnitude of the forces to be overcome at the interface. If a demonstration is not possible, another technique should be considered.

Stitch cutting is generally considered costly. Time and cost increase, particularly when reinforcement must be cut. For diamond core drilling, the harder the aggregate, the shorter the life of the diamond segments, the slower the drilling rate, and the higher the cost.

Additional safety requirements and procedures are required by Engineer Manual 385-1-1 (Ref a) to protect operating personnel from the effects of over-exposure to the high levels of noise produced by the drilling operation. For rotary-percussion drilling, dust must be maintained at acceptable levels, especially in confined areas. Utility lines should be located before drilling operation begins.

PERSONNEL REQUIREMENTS: Well-trained, experienced personnel are required to perform stitch drilling and to maintain equipment.

EQUIPMENT: Rotary-percussion drilling is significantly more expedient and economical than diamond-core drilling. Rotary-percussion drilling is performed with either top-end or down-the-hole hammer. For drilling with a top-end hammer, the hammer is located above the drill hole with the impact force transmitted through extension rods to the bit. A down-the-hole hammer adjoins and accompanies the bit down the hole with the impact force being transmitted directly to the bit with no loss of impact energy. Down-the-hole hammer drilling should be considered when the required hole diameter is greater than 4 in. and the hole depth is greater than 33 ft (Ref b).

Guide tubes or stabilizers may be required for percussion drilling to keep hole straightness within required tolerance needed to maintain overlap between adjacent holes. A deviation of 1 to 2 in. in 10 ft can be maintained with normal drilling methods (Ref b).

BACKGROUND: The stitch-drilling technique employs drilling of overlapping holes to cut out sections of concrete for removal. It was successfully used during the installation of a new bulkhead system for the culverts located within the lock floors of the Panama Canal's Gatun Locks (Ref c). Bulkhead openings in the floors were cut out by drilling 52 overlapping 6-in.-diam holes along the 2.5- by 11.0-ft rectangular-shaped removal perimeter. Holes-intersected ceilings of underlining culverts 3 to 8 ft below the top surface of the lock floor were drilled using diamond core bits operated at 750 rpm's. The concrete core from each hole was removed in two or three sections, depending on the depth of the hole. The first section was cored using a 1-ft-long

barrel; the second, a 4-ft; and the third, a 4-ft with a 4-ft extension. The concrete within the removal perimeter was removed as a unit by crane.

The removal drawings did not indicate any steel reinforcement contained in the concrete to be cut; however, during a stitch-drilling operation, randomly scattered steel railroad tracks were encountered. These were removed by using jackhammers to expose the track within the cut and a torch to cut the track.

Each opening required approximately 305 lin ft of drilling. Totally, 107 openings were cut out using the stitch-drilling technique. The average life of the diamond segments was 90 lin ft.

ENVIRONMENTAL CONSIDERATIONS: A determination should be made as to whether the area to be removed contains coatings or other materials that are considered to be hazardous or toxic. If present, proper handling and disposal under the Resource Conservation and Recovery Act regulations may be required (see Technical Note EI-M-1.2, "Handling and Disposal of Construction Debris"). Precautions should be taken to minimize the travel of noise when drilling is performed in close proximity to groups of people. Concrete removed may be applicable for placement in open water to serve as a fish attractor reef. Several references are available (Ref d, e, f, and g) that contain suggestions for locating, sizing, and marking fish attractors.

COST: The cost of drilling concrete varies widely depending on the job. Estimated cost for diamond-core drilling is about \$80/ft for 7.75-in.-diam hole (6-in.-diam core). The bit is estimated to cost around \$2,000. Rotary-percussion drilling should be several factors cheaper than the diamond drilling (Ref b).

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  - c. Concrete Construction. 1985 (Sep). "Concrete Saws and Drills: What They Do? When Are They Useful?," p 741.
  - d. Nelson, R. W., Horak, G. C., and Nelson, J. E. 1978. "Western Reservoir and Stream Habitat Improvements Handbook," US Department of the Interior, Fish and Wildlife Service, Fort Collins, CO.
  - e. Ryder, L. L. 1981. "Concrete Rubble and Miscellaneous Materials as Artificial Reef Material," Artificial Reefs, D. Y. Aska, ed., Report 41, University of Florida, Gainesville, Florida Sea Grant College, pp 89-91.
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